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Swift 238. The position is 23^h 42^m 16^s, $-28°$ 41′·4.

Swift 239. This is binuclear, at an angle of 250°, with a distance of 20″. The position is 23^h 42^m 33^s, $-28°$ 41′·7.

7807. The position given by Stone is 23^h 56^m 33^s, $-19°$ 19′·6. The position found by me is 23^h 55^m 19^s, $-19°$ 23′·8. On one good night I looked carefully in the place given by Stone and saw no nebula.

The Bruce Micrometer of the Chamberlin Observatory.

By Herbert A. Howe.

(*Communicated by the Secretaries.*)

Through the liberality of Miss Catherine W. Bruce, of New York City, a micrometer adapted to observations of $\Delta\alpha$ and $\Delta\delta$ was built some eighteen months since for the Chamberlin Observatory, by Saegmuller, of Washington, D.C. It was especially intended for work on faint nebulæ. Each nebula is tied to some small star near at hand by micrometric measures of $\Delta\alpha$ and $\Delta\delta$. On some ensuing night, when the Moon obliterates most nebulæ, the comparison star is connected by chronographic and micrometric observations with a catalogued star. The instrument has also been used for a long series of observations of *Eros*, and for similar work on some faint comets. So excellent has been its performance, and so efficient is it for rapid work, that I have been asked by a visiting astronomer to write a detailed description of it.

1. Such a micrometer is usually screwed on to the tail-piece of the equatorial. Whenever it is taken off and replaced, a new value of the parallel, and hence of the zero of the position-circle, must be obtained. The Bruce micrometer slides off, so that when it is put back, the zero of the position-circle is the same as before. The slipping piece, on which the micrometer slides into place, is screwed on to the tail-piece in the usual way, and is fastened by three small steel screws, so that it will not work loose. When the micrometer has been slid into place it is secured by two thumb-screws. The plane in which the sliding takes place is perpendicular to the sight-line of the telescope, and the edges of the run-way are parallel to the declination axis of the equatorial.

2. The position-circle is 9 inches in diameter, and furnished with a system of solid and accurately adjustable stops by which the box can be turned precisely 90° when micrometric measures of $\Delta\alpha$ and $\Delta\delta$ are being made, without reading the graduated circle. If it is desired at any time to have the micrometer box rotate freely, as in measures of double stars, the stops can be thrown back in a few seconds, and when needed again can be swung with equal facility into their former positions. If the box be turned till it is brought up against a stop several times in succession, and the position-circle be read each time, the readings

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will not differ a minute of arc. The circle can be clamped at any angle and a tangent screw used.

3. The eye-piece is swiftly movable a good distance both in right ascension and in declination, so that exceptionally long spider webs can be used. The right ascension wires are eleven in number, the central wire being flanked by two sets of five wires each. In each set the equatorial intervals are 3, 4, 4, and 3 seconds. From the central wire to the nearest of each flanking set is 10 seconds. The entire breadth of this wire system is therefore 48 seconds. By this arrangement three deliberate bisections of an object can be made with a declination wire while it is passing through the field of view, in addition to ten chronographic observations of time. The mean of the times of the bisections in declination is practically the same as the mean of the chronographic times.

The declination wires are nine in number; they are symmetrically spaced; the intervals of the four wires on one side of the central wire are 3′, 2′, 5′, and 5′. The total angular space spanned by the declination wires is therefore 30′. The entire system of declination wires is movable 10′ each side of its central position by the micrometer screw. Thus differences of declination exceeding 30′ may be measured without turning the micrometer screw much. In the hundreds of observations which have so far been made between two objects, one of which was a catalogued star, very few measures of $\Delta\delta$ have exceeded 20′.

The box is provided with an index, so that it may be placed in the centre of its run at any time. So accurately have the spider webs been put in that when the box is in the centre of its run the point of intersection of the two central webs remains upon a star, while the box is being turned through 180° in position angle.

4. For rapid work a coarse micrometer screw, having only twenty threads to the inch, has been considered essential. The screw has three large and boldly divided heads, two of which are movable. Each of the movable heads is furnished with an efficient clamp, which brings no perceptible side-strain on the micrometer screw. If three declination bisections are to be made as a star drifts through the field of view, the two movable heads are first set so that their readings agree with that of the fixed head. When the first bisection has been made, the outer head is clamped. After the next bisection the second head is clamped. For the third and final bisection no clamping is necessary. When the star has passed out of sight the three readings of the micrometer heads are noted. Even when the difference of right ascension of two equatorial stars is only a minute, ten observations of $\Delta\alpha$ and three of $\Delta\delta$ can be made without undue haste. These involve twenty chronographic registrations and six bisections in declination. When the two objects are only a few seconds apart in right ascension, the declination observations are usually made with the driving clock running.

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5. The illumination of each set of wires is effected by two electric lamps of 2 c.p. each, and of about 5 volts. The lamps are so well encased that no stray light bothers the observer. They ordinarily glow with only a fraction of 1 c.p. apiece, and their intensities are so regulated by two rheostats and two mechanical shutters that any required intensity of light may be thrown on each set of wires at any time. In observing a very faint comet or nebula, it is sometimes of advantage to be able to turn the illumination in declination off and on instantaneously, or to have the two sets of wires simultaneously lighted up with different intensities. The lamps are fed by a current from a little transformer, which can be adjusted to any voltage required by them. Through the primary coil of the transformer the regular house-current of 50 volts runs. A four-point switch on the micrometer enables the observer to throw the light on the two verniers of the position-circle or on either set of wires, or on both sets simultaneously.

On the Relation between Magnetic Disturbance and the Period of Solar Spot Frequency. By William Ellis, F.R.S., formerly of the Royal Observatory, Greenwich.

Having in previous papers* compared the variations of diurnal magnetic range with the period of solar spot frequency, I have since given some attention to the relation of magnetic disturbance to solar spot frequency, comparing, as before, results derived from the photographic magnetic records, for so many years maintained at the Royal Observatory, Greenwich, with the corresponding values of sun-spot frequency as tabulated by the late Dr. Rudolf Wolf, of Zürich. Before, however, describing what has been done in this respect, it may be well to make brief reference to some conclusions arrived at in the previous papers.

Magnetic variations, as registered from day to day, include principally the effects of two distinct phenomena : (1) the solar diurnal variation, a local phenomenon which, although everywhere existing, has distinct relation to the local day ; and (2) the apparently irregular magnetic disturbance, a phenomenon of more cosmical character, since when considerable, as in magnetic storms, it is felt simultaneously over widely separated districts of the Earth's surface, the commencement of disturbance when abrupt, as is frequently the case, being absolutely simultaneous at all places, so far as the contracted time scale used in photographic registers will allow us to determine. Magnetic disturbance is not always present ; some days are altogether free from magnetic irregularity, exhibiting only the ordinary diurnal movement, but on other days magnetic irregularity, superposed

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* *Phil. Trans.* for 1880, p. 541, and *Proc. Royal Society*, vol. 63, p. 64.